FIGS. 31–35. OEDOGONIUM CROASDALEAE Jao, sp. nov. (× 315). FIG. 31, upper part of the filament, with two oogonia, six epigynous androsporangia, and three dwarf males, one of which is immature; FIG. 32, upper part of the filament, showing the terminal oogonium; FIG. 33, median part of the oospore seen in polar view, showing the thickened, lamellose, and undulate median wall between smooth outer and finely granulate inner walls; FIG. 34, upper part of the filament, showing a poorly developed oogonium and the suffultory cell, dwarf males, and androsporangia in their usual condition.

SOME FEATURES OF THE FLORA OF THE OZARK REGION IN MISSOURI[1]

JULIAN A. STEYERMARK

To the student of phytogeography the area comprised in the state of Missouri offers a field of exceptional interest mainly on account of the great diversity of its physiographic features, which are the result of its long geological history as a land area. Within the limits of the state are found the low-lying swamp region of the southeast, the comparatively smooth or slightly rolling prairie mostly north of the Missouri River, and south of that great watercourse the vast semi-mountainous, heavily forested Ozark Plateau. The geology of the region is equally diverse. The area to the north of the Missouri River is covered by a nearly continuous sheet of glacially transported soils, clays and gravels, mostly of Kansan drift material, whereas to the south of this stream lies an ancient unglaciated region, the Ozark Plateau, consisting of sedimentary rocks of Paleozoic age with an ancient igneous core of Pre-cambrian origin, the entire Ozark region being one of the oldest land areas on this continent. The Ozark area, together with the Boston Mountains of northern Arkansas and eastern Oklahoma and the Ouachita Mountains of western Arkansas and central Oklahoma, become conspicuous, consequently, as the only prominent series of elevations lying between the Appalachians and the Rocky Mountains to the east and west, and between the Great Lakes and the Gulf of Mexico to the north and south.

It is thus apparent that Missouri should possess a flora of exceedingly diverse elements. It is a cosmopolitan area, botanically speaking, both as a result of this diversity and also because it lies within a definite transition zone where several distinct floristic provinces meet. The Prairie and Great Plains floras enter the region from the west and north; the Coastal Plain and swamp floras from the south and

[1] Published with aid to RHODORA from the National Academy of Sciences.

southeast penetrate the southeast corner of the state; the semi-arid flora of the southwest protrudes slightly into the southern portion; some of the ancient southern Appalachian upland floras appear in various places in the Ozark Plateau; and finally, some of the elements of the Canadian flora from the north and northeast descends into the state, intermixed with the more common Alleghanian element, constituting a truly heterogeneous assemblage of floras of widely diverse origins in time and place.

A general survey of the flora within this area reveals the still more striking and interesting fact that a considerable portion of the flora is a restricted one from the standpoint of distribution within the state. Of course, many of the species have a more or less general range in Missouri; nevertheless, for a large number of them the area of dispersal is restricted. Such limited distribution is often associated directly with a definite type of habitat. Some of the more important explanations that may account for the restriction in habitat and distribution of a species living under its present environmental conditions are that (1) the habitat was selected because the species found in it the optimum conditions for survival—perhaps a definite relationship between soil and water, chemical or physical nature of the substratum, evaporation-exposure ratio, percentage of relative light and shade, etc.; (2) present climatic and physiographic zones—affected by prevailing winds, distribution of rainfall and temperature, relief features, proximity to the sea, altitude, types of substrata, and many other factors; resulting in turn from the past geological history of the land—may have influenced or even forced the species to adapt itself to the conditions and to establish itself there; (3) past geological history may have determined its present known range by the effects of glaciation, diastrophism and orogeny, flooding by continental seas, etc.—that is, a restricted species may be living in territory geologically youthful or may be a relic or endemic because it has been confined within an area geologically more ancient which escaped glaciation or which was not encroached upon by continental seas, or was not influenced, as were surrounding areas, by various forces of diastrophism, orogeny, etc., or it may be an ancient endemic because it survived in a nunatak region; or it may be localized because it is too old to move and has lost its aggressiveness, a fact often shown in many of Dr. Fernald's studies, particularly in his treatise[1] "The

[1] Fernald, M. L. Persistence of plants in unglaciated areas of Boreal America. Mem. Am. Acad. **15**: 239–342. 1925.

Persistence of Plants in Unglaciated Areas" etc. In the case of a given species one or all of these explanations may be needed to account for the present habitat and distribution. In many cases, the geological history may have served as the basic reason for isolating the species in certain areas; in other cases, the geological history may have been the primary cause in isolating the species in a general region, but subsequent causes, such as changes in climatic and physiographic zones, or soil relationships, etc., may have been the secondary and, perhaps, final issue in further limiting the habitat and distribution. There are so many phases to this subject that but a few can be briefly discussed in the present paper.

In connection with the flora of the Ozark region it would appear that geological history has fundamentally determined the broader relationships of the floristic elements, but that other factors have secondarily modified and confined to narrower limits the present native flora. One of the seemingly most important reasons in accounting for certain types of distribution of species found in the Ozark region as well as elsewhere is the chemical nature of the substratum and its associated phenomena. Where other conditions in the environment remain relatively constant in a given region, the soil factor often becomes the deciding one, particularly in regions of residual soils. Dr. Wherry has often brought out the strong correlation existing between the distribution of a species and the chemical nature of the substratum in his numerous studies on soil acidity. Dr. Fernald has often emphasized the chemical nature of the soil as important in the study of plant distribution, and in the case of certain North American species of alpine and subalpine plants has correlated their present distribution with lithological factors.[1] Again, in the area of residual rocks in the Mineral Springs region of Adams County, Ohio, Dr. E. L. Braun[2] found a very striking correlation between the distribution of the various species and the underlying rock component. The summary of this work is as follows: "The most striking correlation between vegetation and any environmental feature of the Mineral Springs region, is the relation of plant communities to underlying rock. The physical and chemical properties of the soils—the available water, the colloidal content, the H-ion,

[1] Fernald, M. L. The soil preferences of certain alpine and subalpine plants. RHODORA **9**: 149–193. 1907.

[2] Braun, E. L. Vegetation of the Mineral Springs region, Adams county, Ohio. Ohio Biol. Surv. Bull. **15**: 513. 1928.

and perhaps, indirectly, the nitrogen content—are affected by or are derivatives of the original rock materials. The primary classification of the vegetation on a geological basis is an acceptance of the importance of this influence which remains apparent throughout all successions." The famous soil chemist, Hilgard,[1] defined a calcareous soil as one which supported a calcicolous vegetation, and one of his chief claims was that the type of soil becomes an important and frequently a decisive factor in determining the distribution of a particular species. Field geologists often recognize the importance of the vegetational covering, and are able frequently to locate definite substrata and horizons by noting certain plant species.

The unglaciated Ozark region in Missouri is one of residual soils arranged in belts of varying width which conform to each geological formation represented. Briefly stated, the southeast portion of the state contains the Archaean rocks which are the oldest in the Mississippi Basin; these rocks are chiefly granites, rhyolites, and porphyritic trachytes. These igneous rocks are found nowhere else in Missouri except for an isolated occurrence in Camden County. Around this ancient igneous core, which forms the nucleus for later formations, occur successively younger and younger sedimentary strata, comprising limestones, dolomites, shales, sandstones, and cherts. These younger rocks surround the igneous core in ring-like belts of varying width and irregularity. The youngest rocks exposed around the margin of the Ozark belt are those of Pennsylvanian age, whereas the oldest, lying immediately about the igneous core, date back to Cambrian. This concentric character of the distribution of Paleozoic formations surrounding the igneous mass is much better developed on the east than on the west slope of the crystalline area. A subordinate center around which the rings are deflected lies in Camden and Laclede counties. Rocks of Cambrian and Ordivician age occupy most of the area of the Ozark Dome in Missouri. Due to this concentric arrangement of the formations the distances by which similar types of rock are separated from each other may be quite marked. Sandstones of one age may be isolated from those of another by intervening outcrops of other types of rocks. For example, a straight line drawn in the southeastern Ozark region in Missouri, from Perryville, Perry Co., southwest to Eminence, in Shannon Co., reveals the occurrence of limestones, dolomites, chert, sandstone,

[1] Hilgard, E. W. Soils: their formation, properties, composition, and relations to plant growth in the humid and arid regions. p. 593. New York. 1907.

and porphyritic trachyte, which, because of their general concentric arrangement in relation to the igneous core, appear in restricted belts.

As found in many other areas of residual soil, rocks of diverse chemical composition result in chemically dissimilar soils, and these, in turn support divergent types of plant associations. However, the occurrence of various species on a definite substratum is well marked in Missouri only when the plant is closely associated with the substratum, i. e., when the residual soil is thin and thus retains the marked chemical properties of the substratum. Conversely, a residual soil which, as a result of much disintegration by weathering and sufficient accumulation of organic matter, has reached a certain depth where it ceases to be little or not at all influenced by the chemical nature of the rock substratum, usually supports species of a more general range whose occurrence is not necessarily limited to the underlying substratum. Soils of this type, often occurring in the deeper deposits of woods, fields, meadows, etc., are frequently circumneutral, and may result from rocks of very dissimilar chemical properties. In such types of soils the factor of acidity or alkalinity in limiting the vegetation is mostly eliminated, or, at least, decidedly counteracted by other factors associated therewith. On these mostly circumneutral types of soils occur many of the common Missouri plants of fields, meadows, and woods. Such woodland species as *Erigenia bulbosa, Dentaria laciniata, Dicentra Cucullaria, Anemone virginiana, Sanicula canadensis, Uvularia grandiflora*, etc., are in this class, and they frequent circumneutral soils which are sufficiently deep, rich, moist, and shaded, regardless of whether the area is one of limestone, sandstone, chert, or granite. Such species, as well as many others of similar habitat, have a more or less general range over the state, probably because the conditions under which they develop are themselves widespread. It is in connection, however, with the species in Missouri which in their distribution within the state occur locally, irregularly, or in conformation to a particular kind of substratum that the soil factor assumes importance. As stated elsewhere, rocks of either basic or acidic properties may give rise to circumneutral soils. Alkaline soils in Missouri result from limestone areas, whereas the acid soils are derived from sandstone, chert, granite, or porphyritic trachyte. Depending upon the degree of leaching which has occurred, both acidic and basic types of soils may result from dolomite or magnesian limestone areas. The acidic condition is produced by extensive leaching, whereby most, if not all, of the calcium carbonate is washed out, leaving the magnesium element in excess. When there is no pronounced amount of leaching the resulting substratum is mostly alkaline. In Missouri, but in the Ozark region in particular, two main types of distribution of species in relation to certain soils are found. One large group comprises the oxylophytes, or, in other words, those confined to or favoring areas of acidic rocks. The other group includes the calciphiles, or those which occur in areas of limestone or other calcareous rocks, and which seem to favor or be restricted to such rocks.

The oxylophytes make up a large proportion of the flora of the sandstone, chert, granite, and porphyritic trachyte areas, especially of the barrens formed by the weathering of these rocks. A list of some typical oxylophytes in Missouri comprises the following:—

Polypodium virginianum L.
Pteridium latiusculum (Desv.) Hier. var. pseudocaudatum (Clute) Maxon
Cheilanthes lanosa (Michx.) Watt
Asplenium pinnatifidum Nutt.
Asplenium Trichomanes L.
Asplenium Bradleyi D. C. Eaton
Thelypteris palustris (Salisb.) Schott var. pubescens (Lawson) Fernald
Thelypteris marginalis (L.) Nieuwl.
Thelypteris spinulosa (O. F. Müll.) Nieuwl. var. intermedia (Muhl.) Nieuwl.
Dennstaedtia punctilobula (Michx.) Moore
Osmunda regalis L. var. spectabilis (Willd.) Gray
Osmunda cinnamomea L.
Lycopodium lucidulum Michx.
Lycopodium complanatum L. var. flabelliforme Fernald
Selaginella rupestris (L.) Spring
Isoëtes melanopoda J. Gay
Pinus echinata Mill.
Erianthus divaricatus (L.) Hitchc.
Andropogon Elliottii Chapm.
Andropogon saccharoides Sw.
Andropogon ternarius Michx.
Sorghastrum nutans (L.) Nash
Digitaria villosa (Walt.) Pers.
Paspalum stramineum Nash
Panicum depauperatum Muhl.
Panicum perlongum Nash
Panicum linearifolium Scribn.
Panicum dichotomum L.
Panicum sphaerocarpon Ell.
Panicum Scribnerianum Nash
Panicum scoparium Lam.
Aristida dichotoma Michx.
Aristida basiramea Engelm.
Aristida ramosissima Engelm.
Aristida longespica Poir.
Aristida intermedia Scribn. & Ball
Aristida lanosa Muhl.
Aristida oligantha Michx.
Aristida purpurascens Poir.
Muhlenbergia tenuiflora (Willd.) BSP.
Muhlenbergia capillaris (Lam.) Trin.
Sporobolus Drummondii (Trin.) Vasey
Agrostis Elliottiana Schultes
Danthonia spicata (L.) Beauv.
Festuca octoflora Walt.
Gymnopogon ambiguus (Michx.) BSP.
Tricuspis elongatus (Buckl.) Nash
Cyperus inflexus Muhl.
Cyperus retrofractus (L.) Torr.
Cyperus filiculmis Vahl var. macilentus Fern.
Fimbristylis Vahlii (Lam.) Link
Scirpus carinatus Gray
Hemicarpha micrantha (Vahl) Pax
Rynchospora capitellata (Michx.) Vahl
Scleria pauciflora Muhl.
Scleria ciliata Michx.
Carex hirsutella Mack.
Carex varia Muhl.
Juncus polycephalus Michx.
Juncus aristulatus Michx.

Luzula campestris (L.) DC.
var. bulbosa A. Wood
Smilax glauca Walt.
Hypoxis hirsuta (L.) Coville
Habenaria peramoena Gray
Spiranthes gracilis (Bigel.) Beck
Goodyera pubescens (Willd.) R. Br.
Carya alba (L.) K. Koch
Carya ovalis Sarg.
var. obovalis Sarg.
Carya Buckleyi Dur.
var. arkansana Sarg.
Quercus marilandica Muench.
Quercus coccinea Muench.
Quercus stellata Wang.
Quercus velutina Lam.
Alnus rugosa (Du Roi) Spreng.
Rumex hastatulus Baldw.
Rumex Acetosella L.
Polygonum tenue Michx.
Polygonum sagittatum L.
Polygonella americana (Fisch. & Mey.) Small
Froelichia floridana (Nutt.) Moq.
Froelichia gracilis Moq.
Anychia polygonoides Raf.
Geocarpon minimum Mack.
Cerastium arvense L.
var. oblongifolium (Torr.) Hollick & Britton
Cerastium viscosum L.
Talinum parviflorum Nutt.
Talinum calycinum Engelm.
Portulaca retusa Engelm.
Portulaca pilosa L.
Ranunculus Harveyi (Gray) Britton
Selenia aurea Nutt.
Sedum Nuttallianum Raf.
Sullivantia renifolia Rosendahl
Saxifraga pennsylvanica L.
var. Forbesii (Vasey) Engl. & Irmsch.
Saxifraga virginiensis Michx.
Desmodium rotundifolium (Michx.) DC.
Desmodium sessilifolium (Torr.) T. & G.
Desmodium rigidum (Ell.) DC.
Desmodium obtusum (Muhl.) DC.
Lespedeza procumbens Michx.
Lespedeza repens (L.) Pers.
Lespedeza striata (Thunb.) H. & A.
Lespedeza hirta (L.) Hornem.
Clitoria mariana L.
Galactia volubilis (L.) Britton
Rynchosia latifolia Nutt.
Polygala verticillata L.
Linum sulcatum Riddell
Linum striatum Walt.
Crotonopsis elliptica Willd.
Acalypha gracilens Gray
var. monococca Engelm.
Tragia cordata Michx.
Ilex verticillata (L.) Gray
var. padifolia (Willd.) T. & G.
Ilex opaca Ait.
Vitis rotundifolia Michx.
Ascyrum hypericoides L.
Hypericum petiolatum Walt.
Hypericum gentianoides (L.) BSP.
Hypericum Drummondii (Grev. & Hook.) T. & G.
Helianthemum Bicknellii Fern.
Lechea villosa Ell.
Lechea tenuifolia Michx.
Viola pedata L.
Viola sagittata Ait.
Viola pallens (Banks) Brainerd
Rhexia mariana L.
Rhexia interior Pennell
Oenothera linifolia Nutt.
Chaerophyllum Tainturieri Hook.
var. floridanum Coult. & Rose
Spermolepis echinata (Nutt.) Heller
Cynosciadium pinnatum DC.
Daucus pusillus Michx.
Nyssa sylvatica Marsh.
Nyssa aquatica L.
Monotropa uniflora L.
Monotropa Hypopitys L.
Rhododendron roseum (Loisel.) Rehder
Vaccinium arboreum Marsh.
var. glaucescens (Greene) Sarg.
Vaccinium stamineum L.
Vaccinium virgatum Ait.
var. tenellum (Ait.) Gray
Vaccinium vacillans Kalm
var. crinitum Fern.
Steironema quadriflorum (Sims) Hitchc.
Polypremum procumbens L.
Frasera caroliniensis Walt.
Apocynum androsaemifolium L.
Phlox bifida L.
Isanthus brachiatus (L.) BSP.
Trichostema dichotomum L.
Hedeoma hispida Pursh
Pycnanthemum incanum (L.) Michx.
Pycnanthemum albescens T. & G.
Cunila origanoides (L.) Britton
Linaria vulgaris Hill
Linaria canadensis (L.) Dumont
var. texana (Scheele) Pennell
Chelone glabra L.
Aureolaria grandiflora (Benth.) Pennell
var. serrata (Torr.) Pennell

Aureolaria flava (L.) Farw.
var. macrantha Pennell
Aureolaria calycosa (Mack. & Bush) Pennell
Aureolaria pectinata (Nutt.) Pennell
var. ozarkensis Pennell
Agalinis heterophylla (Nutt.) Small
Agalinis purpurea (L.) Pennell
Agalinis viridis (Small) Pennell
Plantago aristata Michx.
Plantago virginica L.
Plantago elongata Pursh
Galium arkansanum Gray
Galium pilosum Ait.
Diodia teres Walt.
Mitchella repens L.
Houstonia caerulea L.
Houstonia patens Ell.
Houstonia minima Beck
Houstonia ciliolata Torr.
Valerianella longiflora (T. & G.) Walp.
Liatris squarrosa Willd.
Chrysopsis camporum Rydb.
Solidago petiolaris Ait.
var. Wardii (Britton) Fern.
Solidago caesia L.
Solidago hispida Muhl.
Solidago nemoralis Ait.
Solidago radula Nutt.
Solidago leptocephala T. & G.
Aster patens Ait.
Aster anomalus Engelm.
Aster pilosus Willd.
var. demotus Blake
Aster linariifolius L.
Erigeron pulchellus Michx.
Erigeron divaricatus Michx.
Antennaria plantaginifolia (L.) Richards.
Antennaria fallax Greene
Gnaphalium purpureum L.
Gnaphalium obtusifolium L.
Gnaphalium obtusifolium L.
var. micradenium Weatherby
Ambrosia bidentata Michx.
Coreopsis pubescens Ell.
Helenium tenuifolium Nutt.
Artemisia caudata Michx.
Senecio plattensis Nutt.
Krigia Dandelion (L.) Nutt.
Krigia virginica (L.) Willd.
Hieracium scabrum Michx.
Hieracium Gronovii L.

There is a considerable amount of difference in the degree of toleration of various plants to acidity, and some of the species listed as oxylophiles above may in other places be found extending their range into areas of circumneutral soils.

More rarely are the oxylophytes in this flora confined to one type of rock or to a particular geological formation. So far as is known, *Lycopodium lucidulum* and var. *porophilum, Saxifraga pennsylvanica* var. *Forbesii, Thelypteris palustris* var. *pubescens,* and others occur only in sandstone regions. Even more unusual are those oxylophytes confined to but one geological formation. For example, *Viola pallens, Goodyera pubescens, Dennstaedtia punctilobula,* and *Lycopodium complanatum* var. *flabelliforme* have been found only on the La Motte sandstone, a formation which occurs chiefly in a few counties around the crystalline area in southeast Missouri. *Saxifraga pennsylvanica* var. *Forbesii* and *Sullivantia renifolia* are known only from the St. Peter sandstone area, which circumscribes a narrow but continuous belt along the eastern and northeastern border of the Ozark Dome. The various sandstone areas, particularly the St. Peter and La Motte formations, seem to harbor a more peculiar and restricted flora, species of great rarity or localized occurrence in Missouri, than either the chert or igneous areas. The Roubidoux sandstone, which is the most widely distributed sandstone formation in the Ozark region, occupies a large area in the central Ozark region and persists as the surface rock over some large areas. It is the prevailing surface rock over the extensive sandstone plateau of Dent and adjacent counties. It is the formation which underlies much of the pine forest area in many of the southeastern Ozark counties. Being so widely distributed as a surface or near-surface formation in the Ozark region, it is the chief factor in extending the range of many oxylophytes over a larger area. It is very significant that many calciphiles which in Missouri are found only on limestone or dolomite areas are absent from this area underlain by Roubidoux sandstone. *Grindelia lanceolata* is a typical calciphile, and in Missouri is confined to the Ozark region, but is known only from limestone or dolomite glades or rocky prairies. Abundant on the limestone areas that cap the surface in southwestern Missouri, particularly on the Joachim and Jefferson City limestones, it occurs locally elsewhere in the Ozark region only on limestone north to Camden Co. and east to Jefferson Co. In between, in the portion of the central Ozark Plateau underlain by Roubidoux sandstone, it is entirely absent. *Grindelia lanceolata* is a good example of this sort of interrupted distribution because of intervening sandstone areas occupying the surface formation, and a considerable number of other species in the Ozark region show a similar restriction.

Similarly, the areas of calcareous rock in the Ozark region support a definite and restricted flora. The best examples of this calcicolous type of vegetation are found on the limestone glades and bald knobs. These edaphic areas maintain a characteristic xerophytic flora, some of the species of which are found on the limestone glades of the southern Alleghanies and adjacent plateau regions, limestone areas in Arkansas and eastern Oklahoma, and on portions of the Edwards Plateau and adjacent plateau sections of Texas. A number of species exhibit this type of distribution, as, for example, *Grindelia lanceolata* and *Ophioglossum Engelmanni*. Many of the species occurring on the limestone and dolomite barrens in Missouri are also found on circumneutral to calcareous soils of the prairies of Kansas, Nebraska, Oklahoma, Iowa, Illinois, and adjacent areas. An enumeration of such species includes many of the Leguminosae, Compositae, and Gramineae, such as *Liatris scariosa, Bouteloua curtipendula, Koeleria cristata, Silphium laciniatum, S. integrifolium, Brauneria pallida,* *Solidago rigida, Astragalus distortus, A. mexicanus, Petalostemum purpureum, P. candidum, Amorpha canescens, Psoralea tenuiflora* var. *floribunda, P. esculenta,* etc.

The flora of the limestone glades comprises two heterogeneous elements. One group consists of the typical calciphiles. These are the species having, for the most part, deep roots which penetrate the unleached lower portions of the calcareous substratum and are, consequently, influenced directly by the chemical nature of the rock itself. This group of species is characteristic of the calcareous barrens in Missouri and the prairies in other states. The second group is not at all typical of the limestone barrens and knobs; its component species are those which possess, for the most part, shallow root systems that do not penetrate the deeper portions of the substratum but merely occur within the superficial leached areas of the glade. Such root systems do not penetrate the chemically active parts of the substratum, and are therefore not influenced by alkalinity. This second group of species, then, really comprises true oxylophytes which are characteristically found on the acidic chert, sandstone, or igneous barrens in Missouri, but which also occur on the sterile, leached-out, superficial portions of the calcareous substratum. Such, for example, are *Talinum calycinum* and *Crotonopsis elliptica.* The same sort of situation has been recorded in a number of other areas. For example, in the account of his botanical expedition in Newfoundland, Dr. Fernald,[5] writing of the Blomidon talus-slopes, states, "The freshly broken talus was slightly calcareous and had some of the common calciphiles, but the weathered rock from which the soluble lime had leached was carpeted in patches with the plants we are used to on our granitic mountains, and *Phyllodoce caerulea* was here seen for the first time in the entire summer, and *Stipa canadensis* was apparently new to the island."

A list of typical calciphiles in Missouri includes the following:—

Adiantum Capillus-veneris L.
Notholaena dealbata (Pursh) Kunze
Cheilanthes Feei Moore
Pellaea atropurpurea (L.) Link
Pellaea glabella Mett.
Asplenium resiliens Kunze
Asplenium cryptolepis Fernald
Camptosorus rhizophyllus (L.) Link
Cystopteris bulbifera (L.) Bernh.
Ophioglossum Engelmanni Prantl
Isoëtes Butleri Engelm.
Juniperus virginiana L.
Muhlenbergia cuspidata (Torr.) Rydb.
Spartina Michauxiana Hitchc.
Bouteloua hirsuta Lag.
Bouteloua gracilis (HBK.) Lag.
Melica mutica Walt.

[1] Fernald, M. L. A botanical expedition to Newfoundland and Southern Labrador. Contr. Gray Herb., N. S. 40 [or Rhodora 13]: 133. July, 1911.

Carex eburnea Boott
Carex Crawei Dewey
Zygadenus chloranthus Richards.
Allium stellatum Ker.
Allium mutabile Michx.
Yucca glauca Nutt.
Agave virginica L.
Nemastylis acuta (Bart.) Herb.
Juglans nigra L.
Quercus macrocarpa Michx.
Oxybaphus albidus (Walt.) Sweet
Arenaria patula Michx.
Hepatica acutiloba DC.
Anemone cylindrica Gray
Trautvetteria carolinensis (Walt.) Vail
Clematis Fremontii Wats.
Aquilegia canadensis L.
Delphinium Treleasei Bush
Delphinium Nortonianum Mack. & Bush
Draba cuneifolia Nutt.
Lesquerella gracilis (Hook.) Wats.
Leavenworthia uniflora (Michx.) Britton
Arabis hirsuta (L.) Scop.
Arabis laevigata (Muhl.) Poir.
Descurainia intermedia (Rydb.) Daniels
Erysimum asperum DC.
Heuchera puberula Mack. & Bush
Heuchera parviflora Bartl.
Parnassia grandifolia DC.
Ribes odoratum Wendl.
Malus coronaria (L.) Mill.
Acacia angustissima (Mill.) Kuntze var. hirta (Nutt.) Robinson
Baptisia australis (L.) R. Br.
Cladrastis lutea (Michx. f.) Koch
Psoralea tenuiflora Pursh var. floribunda (Nutt.) Rydb.
Psoralea argophylla Pursh
Psoralea esculenta Pursh
Petalostemum purpureum (Vent.) Rydb.
Petalostemum candidum Michx.
Astragalus mexicanus A. DC.
Astragalus distortus T. & G.
Astragalus lotiflorus Hook.
Oxytropis plattensis Nutt.
Croton capitatus Michx.
Andrachne phyllanthoides (Nutt.) Muell. Arg.
Euphorbia zygophylloides Boiss.
Euphorbia dictyosperma Fisch. & Mey.
Cotinus americana Nutt.
Ilex decidua Walt.
Sapindus Drummondii H. & A.
Rhamnus lanceolata Pursh
Rhamnus caroliniana Walt.
Cissus incisa (Nutt.) Des Moulins
Oenothera missourensis Sims
Oenothera serrulata Nutt.
Gaura coccinea Pursh
Stenosiphon linifolius (Nutt.) Britton
Mentzelia oligosperma Nutt.
Lomatium daucifolium (Nutt.) Coult. & Rose
Eryngium yuccifolium Michx.
Polytaenia Nuttallii DC.
Zizia aurea (L.) Koch
Taenidia integerrima (L.) Drude
Bumelia lanuginosa (Michx.) Pers.
Diospyros virginiana L.
Diospyros virginiana var. platycarpa Sarg.
Gentiana puberula Michx.
Gentiana Andrewsii Griseb.
Centaurium texense (Griseb.) Fernald
Asclepiodora viridis (Walt.) Gray
Acerates viridiflora Ell.
Evolvulus argenteus Pursh
Lithospermum canescens (Michx.) Hitchc.
Heliotropium tenellum (Nutt.) Torr.
Onosmodium subsetosum Mck. & Bush
Onosmodium hispidissimum Mack.
Scutellaria Bushii Britton
Satureia glabella (Michx.) Briquet
Pentstemon Cobaea var. purpureus Pennell
Galium virgatum Nutt.
Houstonia angustifolia Michx.
Campanula rotundifolia L.
Viburnum rufidulum Raf.
Liatris scariosa Willd.
Grindelia lanceolata Nutt.
Grindelia squarrosa (Pursh) Dunal
Gutierrezia dracunculoides (DC.) Blake
Aplopappus ciliatus (Nutt.) DC.
Solidago Gattingeri Chapm.
Solidago Drummondii T. & G.
Solidago rigida L.
Aster oblongifolius Nutt.
Aster sericeus Vent.
Aster laevis L.
Aster azureus Lindl.
Aster ptarmicoides T. & G.
Silphium laciniatum L.
Silphium terebinthinaceum Jacq.
Silphium integrifolium Michx.
Berlandiera texana DC.
Parthenium integrifolium L.
Parthenium repens Eggert

Rudbeckia fulgida Ait.
Brauneria pallida (Nutt.) Britton
Brauneria paradoxa Norton
Marshallia caespitosa Nutt.
Palafoxia callosum T. & G.
Thelesperma trifidum (Poir.) Britton
Thelesperma gracile (Torr.) Gray
Cacalia tuberosa Nutt.

Rarely do the calciphiles occur on acidic rocks. *Aquilegia canadensis, Carex eburnea, Cystopteris bulbifera, Adiantum Capillus-Veneris, Camptosorus rhizophyllus*, and other calcicolus species have been found on the highly siliceous St. Peter and La Motte sandstones, but in these cases some calcium carbonate may have been introduced extraneously, perhaps washed down from above, brought in from seepage-water, or otherwise introduced.

The foregoing discussion has called attention to some obvious general relationships existing between various species in Missouri and the underlying substratum. There is another aspect of this relationship which should be suggested, namely, the frequent association of a species at or near the margin of its range with a definite habitat. The interesting feature observed here is that a number of such species in Missouri are found on a marginal habitat at variance with that in which they occur in the other portions of their range which are near the dispersal center. This divergence between a marginal habitat and one near the center of dispersal for the species is well brought out in the following cases. The most common examples are species which in their usual and most abundant areas of distribution grow in acid swamps, wet woods and meadows, boggy ground, and the like. Species frequenting such habitats in their normal areas of distribution inhabit in Missouri regions of moist shaded cliffs or wet ledges of an acidic nature. The acid substratum usually selected by these species is sandstone. The following species exemplify this point:—1) SAXIFRAGA PENNSYLVANICA var. FORBESII.—Typical *Saxifraga pennsylvanica* of the northern and eastern states is a plant of wet woods and meadows. On coming south into Illinois, and Missouri it is replaced by the closely related *Saxifraga pennsylvanica* var. *Forbesii* which appears only on moist shaded sandstone cliffs. 2) VIOLA PALLENS—A common enough species of wet springy ground and brooksides in the northern and eastern portion of its range, it appears in Missouri at the southwestern limit of its dispersal in but one place known, that on moist La Motte sandstone cliffs.

Other examples illustrate the occurrence of species which appear in the swampy lowlands of southeastern Missouri and persist in scattered areas north of this region on acidic substrata. *Osmunda cinnamomea* and *O. regalis* var. *spectabilis* both are species common in wet woods, meadows, or swamps in the greater portion of their range. In Missouri they are found in such habitats in the lowlands of the southeastern portion of the state; yet northward in the state the only places where they seem to thrive are crevices and pockets of moist shaded or mossy sandstone, granitic, or porphyritic trachyte cliffs, or along rocky streams of these substrata. *Polypodium polypodioides*, a species of the lowlands of the South Atlantic states, Gulf Coastal Plain, and Mississippi Embayment dispersal, is common on trees in the southeastern lowland region of Missouri: north and west of this area it protrudes frequently further on various sandstone, granites, and porphyritic trachytes, reaching its northernmost known occurrence in the state on a shaded bluff of St. Peter sandstone. *Mitchella repens*, a common plant either of dry sterile acid woods, thickets, and pastures, or acid peaty places in the northern and eastern portions of its range, and frequently in swampy localities in the Gulf Coastal Plain and Mississippi Embayment regions, extends up the Mississippi Valley as a characteristic plant of the lowlands of southeastern Missouri. Although northward in eastern Missouri it has been found locally in a number of places, these again and again are moist sandstone bluffs or banks of an acidic nature. *Hypericum petiolatum* and *Cardamine bulbosa* are additional examples of species which are common in swampy places both in southeastern Missouri and in other portions of the dispersal area, and northward in the state inhabit moist sandstones or other acidic rocks. *Lycopodium lucidulum* is an interesting example of a species which in the northern and eastern portions of its range is common in usually shaded woods. On coming southwestward into Ohio, Indiana, Illinois, Iowa, and Missouri it is found only on shaded sandstone bluffs; likewise, its variety, *Lycopodium lucidulum* var. *porophilum*, appears in similar situations.

There is yet another relationship found to exist between the occurrences of various Missouri species and the underlying rock substratum, namely, the range extensions effected by the substratum. Cases are numerous where certain types of rocks, particularly sandstones, provide in Missouri extensions of ranges for species which are rare or local, boreal or austral, or for ancient types—those with geologically ancient types of dispersal. Species of great rarity in Missouri, such as

Sullivantia renifolia, Saxifraga pennsylvanica var. *Forbesii,* and others, are known to occur only on St. Peter sandstone. Species of more northern affinities which extend southward into Missouri in the Ozark region on certain types of rocks are *Galium boreale* var. *hyssopifolium, Campanula rotundifolia, Zygadenus chloranthus* on limestone; *Goodyera pubescens, Viola pallens, Lycopodium complanatum* var. *flabelliforme* and *Dennstaedtia punctilobula* on La Motte sandstone; *Thelypteris palustris* var. *pubescens, Lycopodium lucidulum* var. *porophilum, Polypodium virginianum, Thelypteris spinulosa* and var. *intermedia,* on various sandstones and other acidic types of substrata. Of species of more southern affinities which extend northward into the Ozark region on particular rock substrata may be mentioned *Hypericum petiolatum* and *Polypodium polypodioides.* The species limited to the unglaciated southern Appalachian and Ozarkian region and therefore of particular interest as representing ancient types of dispersal are *Parnassia grandifolia, Trautvetteria carolinensis, Cheilanthes alabamensis, Ophioglossum Engelmanni, Isoëtes Butleri, Nemastylis acuta, Baptisia australis, Heliotropium tenellum, Grindelia lanceolata, Solidago Gattingeri* usually on limestone exposures in the Ozark region, and *Berberis canadensis, Asplenium Bradleyi, Houstonia patens* on sandstone exposures.

The examples brought out in the foregoing discussion illustrate a few of the interesting distributional relationships of various species with the substratum, and emphasize the fact that the type of underlying substratum is one of great importance in the distribution of these species in a region of residual soils such as that of the Ozark region of Missouri, and therefore becomes greatly significant in discussing the phytogeographical problems in the region concerned.

The last feature of great phytogeographic interest in Missouri to be discussed is the relative antiquity of the Ozarkian flora. Dr. Fernald[1] emphasizes this point in his introduction concerning some phytogeographic features of the eastern North American flora as follows: "Viewed from the standpoint of availability for occupation by flowering plants, the oldest large section of the region is the southern half of the Appalachian Upland, extending from central New York to northern Georgia and northern Alabama, and west of the Mississippi represented by the Ozark Plateau. Never, since it was first occupied by angiosperms, has the Appalachian Upland of the

[1] Fernald, M. L. Specific segregations and identities in some floras of eastern North America and the Old World. RHODORA 33: 25–27. 1931.

United States been invaded by seas; and, except for its northern extension, it lies wholly south of the limits of the Pleistocene glaciation. During the Cretaceous, while this southern half of the Appalachian region was covered by land-vegetation, the lower marginal country, east, south and far to the west and northwest, was submerged under the Cretaceous seas. In the Tertiary, likewise, much of the low-lying Coastal Plain was again covered by shallow seas; and, furthermore, the outer margin of the Coastal Plain is often of very modern or Quaternary origin." Map I of his article illustrates the ancient southern Appalachian-Ozarkian portion of eastern North America as one exposed since the close of the Paleozoic and available for plant occupation in eastern North America since the close of this era.

The Ozark Plateau of Missouri and Arkansas, with minor extensions into southern Illinois, southeastern Kansas, and adjacent eastern Oklahoma, has, like the southern half of the Appalachian Upland, been exposed as a land area since the close of the Paleozoic era. Like this Appalachian area, the Ozark region was uplifted at the close of the Cretaceous period, but during early Tertiary became peneplained following a long period of erosion. Over much of the Tertiary period the Ozark region was a plain of low relief covered by a luxuriant forest flora, and similar again to the peneplained southern Appalachian area this Ozark region of low relief was in Tertiary only slightly above sea-level, while the region to the south, east, and west was covered by shallow seas. At this time the great northern extension of the Gulf, known as the Mississippi Embayment, lay south and east of the Ozark area. The Mississippi Embayment became obliterated, however, towards the close of the Tertiary when another and final uplift elevated the Ozark region, which destroyed or pushed south the lowland forest that had previously occupied it. Some of this forest persists today in the lowland region of southeastern Missouri.[1] The same uplift near or towards the close of the Tertiary which hastened the extinction or migration south of much of the mesophytic flora which had covered the peneplained Ozark area, ushered in conditions making for a xerophytic or semi-xerophytic environment.

These significant geological data have a very important bearing upon the explanation of the restricted and limited ranges of a number of species in eastern North America. Both the southern Appalachian

[1] Palmer, E. J. The forest flora of the Ozark region. Jour. Arn. Arb. **2**: 229–232. 1921.

Upland and the Ozark Plateau have had somewhat similar geological history. Since the close of the Paleozoic era, each has remained an area of land standing above sea-level; each has experienced its uplifts and peneplanations, these sometimes occurring at the same geological epoch; each has witnessed its changes in flora, mesophytic types being succeeded by xerophytic ones, and vice-versa. Following the close of the Paleozoic, at times (during Mesozoic and Tertiary) when adjacent areas to the south, east, and west were flooded or submerged by continental seas, and again in the Pleistocene when areas to the north were being glaciated, the southern Appalachian-Ozarkian areas enjoyed a continuous land history. As such, both areas were able to harbour many species at times when adjacent areas were not available. Some of this flora may have had a broad dispersal from the Appalachians west to the Ozark area, but later became restricted to the southern Appalachians and the Ozark area when the flooding in adjacent areas led to exterminations. Cretaceous and Tertiary submergence of some adjacent regions, and Pleistocene glaciation of others necessarily limited the areas of distribution, and the species common to the southern Appalachian-Ozark region either have persisted there as relics or remants of an older dispersal or were forced to migrate to these land areas from other regions, or both. It appears probable that the species restricted to the southern Appalachian-Ozarkian territory, in all probability representing relics, originated in Mesozoic time, perhaps at the close of the Cretaceous period, following the uplift over the Appalachian Upland Ozark Plateau. Certainly, the species common to these two areas must have been occupying them before the Tertiary intrusion of the Mississippi Embayment, which all but broke up the territory of dispersal which formerly bridged the gap between the southern Appalachians and the Ozark Plateau. At present, only a narrow strip of the old land mass of the Ozark area remains in southern Illinois as a bridge over this otherwise enormous gap caused by the embayment.

It would appear, then, that in the southern Appalachian-Ozarkian region is to be found a center of dispersal of ancient types of species, which are as old as any in eastern North America. An investigation of the flora of this ancient area shows that there have been at least three definite centers of origin and dispersal of these old types—of relic groups of species originating or persisting on this old land mass. These centers comprise: (1) species common to both the southern

Appalachians and the Ozark Plateau and restricted thereto or also represented south and west of these two areas from which they have probably spread; (2) species restricted to the southern Appalachian area—old types which have originated in this area and are still persisting therein; and (3) species restricted to the Ozark Plateau and region southwest and west of it. Since only the first and third of these areas include Missouri species, discussion will be limited to these regions.

The list of species common to both the southern Appalachian Upland and the Ozark Plateau area include the following. It should be noted too that some of the species listed here occur somewhat south, north or west of the main area, since the original dispersal from the distributional center.

Cheilanthes alabamensis (Buckley) Kunze
Asplenium Bradleyi D. C. Eaton
Asplenium pinnatifidum Nutt.
Ophioglossum Engelmanni Prantl
Isoëtes Butleri Engelm.
Paspalum circulare Nash
Panicum xalapense HBK.
Panicum polyanthes Schultes
Aristida Curtissii (Gray) Nash
Aristida ramosissima Engelm.
Sporobolus canovirens Nash
Cyperus refractus Engelm.
Cyperus ovularis (Michx.) Torr.
Carex mesochorea Mack.
Juncus diffusissimus Buckley
Luzula campestris (L.) DC.
var. bulbosa A. Wood
Stenanthium robustum S. Wats.
Trillium viride Beck
Agave virginica L.
Iris cristata Ait.
Nemastylis acuta (Bart.) Herb.
Habenaria peramoena Gray
Salix longipes Shuttlw. var. Wardii (Bebb) Schneider
Ulmus alata Michx.
Celtis pumila Pursh
var. georgiana (Small) Sarg.
Trautvetteria carolinensis (Walt.) Vail
Magnolia acuminata L.
Berberis canadensis Mill.
Draba brachycarpa Nutt.
Leavenworthia uniflora (Michx.) Britton
Arabis virginica (L.) Trel.
Cardamine rotundifolia Michx.
Sedum pulchellum Michx.
Sedum Nevii Gray
Heuchera parviflora Bartl.
Heuchera puberula Mack. & Bush
Parnassia grandifolia DC.
Aruncus sylvester Kostel.
Gillenia stipulata (Muhl.) Trel.
Agrimonia rostellata Wallr.
Potentilla canadensis L.
var. villosissima Fernald
Baptisia australis (L.) R. Br.
Cladrastis lutea (Michx. f.) Koch
Psoralea Onobrychis Nutt.
Psoralea pedunculata (Mill.) Vail.
Robinia Pseudo-Acacia L.
Desmodium ochroleucum M. A. Curtis
Lespedeza simulata Mack. & Bush
Cotinus americana Nutt.
Rhamnus caroliniana Walt.
var. mollis Fernald
Vitis rupestris Scheele
Tilia heterophylla Vent.
var. Michauxii (Nutt.) Sarg.
Viola emarginata (Nutt.) Le Conte
Passiflora lutea L.
Eulophus americanus Nutt.
Ligusticum canadense (L.) Britton
Vaccinium arboreum Marsh.
Vaccinium neglectum (Small) Fernald
Vaccinium melanocarpum Mohr
Vincetoxicum carolinense (Jacq.) Britton
Vincetoxicum Baldwinianum (Sweet) Britton
Phacelia dubia (L.) Small
Phacelia bipinnatifida Michx.
Heliotropium tenellum (Nutt.) Torr.
Monarda Bradburiana Beck

Satureia glabella (Michx.) Briquet
Pycnanthemum albescens T. & G.
Cunila origanoides (L.) Britton
Galium virgatum Nutt.
Houstonia minima Beck
Houstonia purpurea L.
Houstonia angustifolia Michx.
Houstonia patens Ell.
Lonicera flava Sims
Viburnum rufidulum Raf.
Triosteum angustifolium L.
Lobelia leptostachys A. DC.
Eupatorium sessilifolium L.
Grindelia lanceolata Nutt.
Solidago petiolaris Ait.
Solidago Gattingeri Chapm.
Silphium Asteriscus L.
Rudbeckia fulgida Ait.
Verbesina virginica L.
Coreopsis grandiflora Hogg.
Coreopsis pubescens Ell.
Cirsium virginianum (L.) Michx.

A study of the habitats of the various species in this first category shows that over half of this flora (60 percent) grows in a xerophytic environment—barrens, dry bluffs, dry rocky hillsides, prairies, and similar exposed and semi-arid situations. The herbaceous types comprise about 80 percent of the species represented.

The other great developmental center of relatively ancient types is the Ozark Plateau and the adjacent area to the west and southwest. In some instances species originating in this area are represented slightly to the east or southeast of the main area, but have spread mostly westward and southwestward; some of this class are found as far south as the Mexican plateau or as far west as Arizona. The following list comprises species restricted to the Ozark area and the region west and southwest (some of these are known only from the Ozark region):—

Notholaena dealbata (Pursh) Kunze
Panicum obtusum HBK.
Panicum malacophyllum Nash
Sporobolus asper (Michx.) Kunth
  var. pilosus (Vasey) Hitchc.
Sporobolus Drummondii (Trin.) Vasey
Carex austrina (Small) Mack.
Wolffia papulifera C. H. Thompson
Yucca arkansana Trelease
Sisyrinchium flaviflorum Bicknell
Quercus velutina Lam.
  var. missouriensis Sarg.
Castanea ozarkensis Ashe
Celtis laevigata var. texana Sarg.
Geocarpon minimum Mack.
Arenaria stricta Michx.
  var. texana Robinson
Talinum calycinum Engelm.
Nymphaea ozarkana Miller & Standley
Ranunculus Harveyi (Gray) Britton
Clematis versicolor Small
Clematis Fremontii Wats.
Delphinium Treleasei Bush
Delphinium Nortonianum Mack. & Bush
Corydalis crystallina Engelm.
Lesquerella gracilis (Hook.) Wats.
Lesquerella angustifolia (Nutt.) Wats.
Selenia aurea Nutt.
Sedum Nuttallianum Raf.
Saxifraga texana Buckley
Hamamelis vernalis Sarg.
Crataegus coccinioides Ashe
Crataegus lanuginosa Sarg.
Prunus hortulana Bailey
Rynchosia latifolia Nutt.
Acacia angustissima (Mill.) Ktze.
  var. hirta (Nutt.) Robinson
Andrachne phyllanthoides (Nutt.) Muell. Arg.
Euphorbia zygophylloides Boiss.
Sapindus Drummondii Hook. & Arn.
Aesculus glabra Willd.
  var. leucodermis Sarg.
Cissus incisa (Nutt.) Des Moulins
Callirhoë digitata Nutt.
Callirhoë Bushii Fernald
Viola Lovelliana Brain.

Oenothera missouriensis Sims
Opuntia macrorhiza Engelm.
Cynosciadium pinnatum DC.
Lomatium daucifolium (Nutt.) Coult. & Rose
Chaerophyllum texanum Coult. & Rose
Sabbatia campestris Nutt.
Centaurium texense (Griseb.) Fernald
Centaurium calycosum (Buckl.) Fernald
Onosmodium subsetosum Mack. & Bush
Scutellaria Bushii Britton
Physalis missouriensis Mack. & Bush
Amsonia illustris Woodson
Collinsia violacea Nutt.
Pentstemon Cobaea Nutt. var. purpureus Pennell
Pentstemon tubiflorus Nutt.
Pentstemon arkansanus Pennell
Aureolaria pectinata var. ozarkensis Pennell
Aureolaria calycosa (Mack. & Bush) Pennell
Ruellia pedunculata Torr.
Galium arkansanum Gray
Valerianella stenocarpa (Engelm.) Krok
Valerianella longiflora (T. & G.) Walp.
Vernonia crinita Raf.
Gutierrezia dracunculoides (DC.) Blake
Solidago radula Nutt.
Solidago Drummondii T. & G.
Solidago Lindheimeriana Scheele
Chaetopappa asteroides DC.
Boltonia latisquama Gray
Aster anomalus Engelm.
Erigeron tenuis T. & G.
Berlandiera texana DC.
Parthenium repens Eggert
Brauneria paradoxa Norton
Polypteris callosa (Nutt.) Gray
Gaillardia lutea Greene
Artemisia mexicana Willd.
Centaurea americana Nutt.
Krigia occidentalis Nutt.
Marshallia caespitosa Nutt.

An examination of this list also reveals results similar to those of the preceding, but showing more striking differences. Here about seven-eighths of the species comprising this flora grow under a xerophytic type of environment. Moreover, the herbaceous component amounts to 85 percent of the whole.

From an examination of the preceding lists it is evident that herbs comprise by far the majority of the species limited to the southern Appalachian-Ozarkian area of dispersal as well as to the Ozarkian Plateau and adjacent region. The herbaceous species which comprise the majority of the flora peculiar to the Ozark Plateau region represent at present the characteristic and dominant xerophytic flora of that region. These types seem either to have originated in the Ozark Plateau or to have spread into it on the dry uplands and barrens as a response to the xerophytic conditions occasioned by the last uplift of this region, which probably occurred either in late Tertiary or slightly later.[1], [2] Since the Cretaceous sea-bottoms underlying the Great Plains region were uplifted in early and again in late Tertiary times more or less coincident with the last Ozark diastrophism, it is likely that favorable opportunities were brought about for an incursion of the prairie flora into the Ozarks, during Tertiary times and

[1] Keyes, C. R. Age of Ozark Uplift. Mo. Geol. Surv. Ann. Rept. 7: 351–352. 1895.

[2] Keyes, C. R. Myth of the Ozark Isle. Science N. S. 7: 588–589. 1898.

vice-versa, resulting in the intermingling of the prairie and glade flora that we at present encounter. It is probable that most, if not all, of the species restricted to the southern Appalachian-Ozarkian area were in the Ozark region long before the other species of the prairies and glades which originated in the Ozark Plateau itself or spread into it from adjacent regions to the west or southwest. As has already been stated, the flora peculiar to the Ozark Plateau or to it and adjacent region west and southwest either originated in the Ozark region or spread into it when the last Tertiary uplift through that region resulted in elevated rocky glades and prairies in a drier and more semi-arid environment which favored the occupation by mostly xerophytic types of plants. Long before this uplift, however, the southern Appalachian-Ozarkian floristic element must have been dispersed before the northern intrusion of the Mississippi Embayment had all but severed its common connection. We have already seen that the southern Appalachian-Ozarkian flora probably originated sometime in the Mesozoic, perhaps following an uplift over these areas towards the close of the Cretaceous period. This latter flora, therefore, is probably the most ancient to be found in the Ozark region today. Thus, it may be concluded on the basis of the foregoing discussion that two geologically diverse floras occur in the Ozark region, (1) an ancient relic flora common to the southern Appalachians and Ozark region, and dating back in all probability to the uplift that occurred at the close of the Cretaceous, and (2) a younger flora, characteristic of the uplands and barrens of the Ozarks, a flora which probably originated in Tertiary times when this region was re-elevated in late Tertiary.

Missouri Botanical Garden, St. Louis, Missouri.

DOUBLE FLOWERS IN THE WILD SWAMP BLUEBERRY, VACCINIUM CORYMBOSUM

H. F. Bergman

(Plate 289)

Abnormal flowers in any species of *Vaccinium* are almost unknown. The only cases reported by Penzig (3) are adesmie of the corolla in *V. dialypetalum* J. J. Sm., and tetramery or occasional trimery in *V. uliginosum* L., which are minor abnormalities. Weatherby (5) has